Software Package Modification Issues in Manufacturing

Revised Summary Report
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I. Management Summary

INPUT interviewed 83 manufacturing organizations to understand the relative importance and acceptance of different technologies that could assist in the modification of software packages.

One of the chief findings is that when acquiring packaged software over half of respondents placed considerable importance on modifiability -- either by themselves or as capabilities built into a software product. However, this should be put into context; a larger number of respondents placed as much or more emphasis on more "traditional" evaluation criteria such as ease of integration, features, vendor reputation or client/server technology.

- To a large extent this difference in relative shows that evaluation criteria have been changing slowly.
- Another element is that many respondents are not sure whether greatly improved modifiability is in fact achievable: To some extent, respondents had to "suspend belief" in order to rate modifiability issues.

The most important elements affecting modifiability are:

- Knowledgeable staff
- Documentation and source code

The programming language and the structure and quality of the actual code were, as a class, seen as less important. Again, these ratings largely represent experience to date, i.e.,

- Most customers have not seen that the language used in a package is a primary factor in maintainability
- In fact, up to now many packages explicitly or implicitly discourage changing or adding to the actual code.

These findings are reinforced when examining the acceptability of specific enabling technologies for improved software modifiability.

- Relational and distributed DBMS technology was rated appreciably higher than object-oriented databases or object-oriented design.
- Packages built with CASE tools ranked lowest of all.
- In INPUT's opinion, these lower ratings for object oriented and CASE are a result of lack of knowledge and experience as well as residual doubts over the applicability of the underlying technology.

In looking at the importance of specific languages for modifications, the key factor is that, to date, languages themselves are not viewed as critical elements in modifiability. With that reservation the following observations can be made:

- C++ is seen as important by about one-third of respondents.
- Cobol receives about as high a rating.
- Smalltalk is seen as important by only a small minority of respondents.

INPUT concludes from this that:

- Customer minds are still open on the language issue.
- Using C++ as a vehicle could produce higher levels of immediate acceptability.
- Customers could be convinced that there is a "better mousetrap". However, this would require an initial education effort that to be convincing would require hard evidence.

II. Methodology

INPUT interviewed IS staff in 83 manufacturing organizations in November 1992 to understand the acceptability of particular technologies, especially technologies affecting modifiability of software packages by customers. Interviews were held with companies across manufacturing. Both large (over $1 billion) and medium-sized companies (those between $100 - 999 million) were interviewed.

The questionnaire and the following analysis includes the following items.

- Replacement plans for eight specific applications (financial applications, warehouse management, factory management, human resources, order processing, MRP, engineering and procurement). This data is in Appendix A.
- Evaluation criteria used in acquiring software packages. (Note: Prior research had essentially established that utilizing software packages is a major part of most companies' plans.)
- Establishing the relative importance of potential elements to make packaged software more modifiable. These elements were specified in the interview and included:
  - Access to knowledgeable technical staff
  - Availability of documentation
  - Access to source code
  - Adherence to standards by the software package
  - The structure and quality of the code
  - The actual programming language used
- The acceptability of specific enabling technologies for ensuring improved software modifiability. The technologies which respondents were asked to rate included relational DBMS, distributed DBMS, object-oriented databases, object-oriented design, packages built with CASE tools supplied to customer, written in C++, written in Smalltalk, written in another language.
- The acceptability of specific languages was also analyzed.

The questionnaire used is in Appendix B.

III. Software Package Evaluation Criteria

Exhibit 1 shows the percent of respondents which gave high ratings for specific software package evaluation criteria. All of the criteria were seen as important by at least half the respondents.

- Ease of integration was the most important factor. There were a number of comments on this from respondents. Representative comments include:
  - "Vendors must adapt to our environment -- which is constantly changing."
  - "Vendors must have built-in flexibility in their products."
- Standards, features and vendor reputation were almost as important.
- Vendor-provided product modifications was seen as the least important, relatively speaking; however, even this factor averaged 3.4 on a scale of 5 -- a medium/high rating of importance from an absolute standpoint. INPUT believes that this is a result of lack of knowledge as well as some uncertainty over the feasibility of such offerings.

Other research that INPUT has conducted has shown similar findings.

- A recent in-depth study of how large projects were planned and awarded showed that as end users became further involved in the planning process, formal criteria as used by IS organizations became less important. (One respondent to the current study echoed this and said, "Internal customers are becoming much more independent.")
- In these end user settings, a particular factor often becomes a "knock-out" factor. These knock-out factors emerge during the review process. They are not known in advance and vary widely.
- Technical criteria tend not to be primary, in the sense that candidates must be above a certain threshold of performance. After that point, the extent to which an offering meets business requirements often becomes controlling.

IV. Elements of Modification

Respondents were asked to rank the six elements impacting modifiability shown in Exhibit 2. The issues of generalized "access" were given first or second place by almost half the respondents. ("Access" includes access to staff, documentation and source code.)

More specific elements (standards, code characteristics and the programming language used) were seen as less important. Note that the programming language used was placed last or next to last by almost half of respondents. Respondents stated repeatedly that they had no preference on the language used by an application.

The companies interviewed had many different attitudes toward modifiability, which may be one reason why the more general aspects of this issue were valued more highly. These conflicting attitudes are illustrated by the following sampling of comments:

- "We prefer to do our own modifications."
- "We don't like to spend a lot of time on modifications."
- "We don't have to make many changes to packages."
- "We are used to doing everything ourselves."
- "Vendor-provided modifications are good but expensive."
- "Installation support is not as critical as finding the right package in the first place."
- "I could go on forever on the importance of software being modifiable by customers."
- "We tend to customize packages."
- "Packages should be user-friendly."

V. Enabling Technologies for Improving Software Modifiability

Exhibit 3 shows the degree of acceptability of differing enabling technologies from the choices that were offered to respondents. DBMS-related technologies received the highest ratings and occupy the first three places on this list.

It can be argued that the choice of a DBMS (with the possible exception of an object-oriented DBMS) does not have much to do with modifiability. It should be kept in mind that modifiability, per se, is not the key factor in most of the respondents' minds (see Exhibit 1). INPUT believes that many respondents rated relational DBMSs highly because of the perception that these products are inherently flexible; "flexibility" can be seen as overlapping "modifiability".

Object-oriented databases, object-oriented design and built-in CASE tools ranked somewhat lower because respondents were dealing with immature - and rapidly changing - technologies. It was clear that many respondents were faced with the need to "suspend their disbelief" over whether or not the enabling technologies would in fact be able to deliver these benefits.

VI. Specific Languages Used in An Application

In Exhibit 2, languages as a vehicle for improved software modifiable received the lowest ratings. An equally important finding is that in general respondents exhibited a considerable lack of knowledge and, to some degree, a lack of interest in the language issue. Responses were repeatedly, "No preference", "Doesn't affect us", etc.

Exhibit 4, shows the importance of particular languages for modification purposes.

- C++ was cited the most often. This rating was at least as much a result of general impressions as actual experience. It is noteworthy that C++ was only cited when respondents were specifically asked to rate languages -- C++ was not volunteered in other parts of the interview.

- Cobol on the other hand was not only cited by 19% of respondents as important for modification purposes. but an additional 14% volunteered Cobol during other parts of the interview. Thus, the total mentions of Cobol were on about the same level as for C++. As one respondent put it, "Don't exclude Cobol."

C++ and Smalltalk are sometimes seen as competing for the same object-oriented position. C++ was cited far more often than Smalltalk. However, INPUT believes that these numbers should not necessarily be interpreted as evidence that C++ is far more acceptable than Smalltalk.

- There were relatively few volunteered observations on either language and not many more received as a result of specific probing.

- Many respondents felt that "no preference" regarding the language used meant just that.

INPUT believes that the relative size of the response between C++ and Smalltalk is tied closely to general levels of awareness. The difference between C++ and Smalltalk in this survey is consistent with overall visibility between the two:

- In a large computer subject data base there are over 1,500 entries for C++ over the last 12 months, compared to 65 for Smalltalk.

- In the software reference "Data Sources", there are over 500 products concerned with C++ and under 40 for Smalltalk.

- These ratios are strikingly similar to those found in the survey.

INPUT does not conclude from this study that new packages should be written in Cobol (although INPUT is aware of "client-server" offerings that are based in Cobol and assembler). But people are comfortable with Cobol, especially those looking at large systems and/or based in large IS departments (the source of most of the study's respondents). This is illustrated in the comments:

- "Cobol is what we have."
- "That's where my people's skills are."
- "Cobol is a world power."

As stated before, these comparative ratings for different languages should be analyzed in the overall context of the lack of preference of the underlying language used by a software package (Exhibit 2).

INPUT concludes from this that:

- Customer minds are still open on the language issue.
- Using C++ as a vehicle could produce higher levels of immediate acceptability.
- Customers could be convinced that there is a "better mousetrap". However, this would require an initial education effort that to be convincing would require hard evidence.

Appendix A

Replacement Rate for Manufacturing Applications

Exhibit A-1 shows the expected replacement rates for eight manufacturing applications.

- Respondents gave a probability of replacement for each application. On the average close to half of all applications had a probability of over 50% of replacement in the next five years.
- For each application almost a quarter of respondents sees a probability of 95% or higher of replacing the application.
- The financial group of applications has a somewhat higher probability of replacement, probably owing to having interfaces to many applications in the group: If other applications are replaced, there is increased pressure on replacing financial applications as well.

This survey did not specifically ask if respondents planned to use software packages as replacements. However, several other recent studies have established that software packages are increasingly the replacement vehicle of choice. This appeared to be the same assumption in this interview group. However, they also saw that a package would only go so far in meeting their needs, as shown by these sample comments:

- "If it's good software, it doesn't need much support, but I've never seen off-the-shelf software that doesn't need work."
- "It's hard to find a package that does 100% of what you want it to do."
- "One of our package vendors went out of business and caused us a lot of problems."

Exhibit 1

IMPORTANCE OF SOFTWARE PACKAGE EVALUATION CRITERIA

Criteria	Importance (% Respondents Rating 4 or 5*)
Easy to integrate	88%
Conforms to standards	77%
Extensive Built-in Features	76%
Vendor reputation	74%
Full Installation Support	69%
Client/Server Technology	68%
Software Modifiable by Customer	62%
Hardware Independent	56%
Vendor-provided Product Modifications	52%

*1 = lowest importance, 5 = highest importance

Exhibit 2

IMPORTANCE OF MODIFICATION ELEMENTS

Elements	Importance: % Rating First or Second	Importance: % Rating Fifth or Sixth
Access to knowledgeable technical staff	49%	21%
Documentation availability	46%	23%
Access to source code	42%	19%
Adherence to standards	30%	27%
Structure and quality of code	27%	28%
The programming language used	25%	44%

Note: Some respondents gave multiple "firsts".

Exhibit 3

ACCEPTABILITY OF ENABLING TECHNOLOGIES FOR IMPROVED SOFTWARE MODIFIABILITY

Technology	Acceptability (% rating 4 or 5*)
Relational DBMS	80%
Distributed data base technology	65%
Object-oriented database	60%
Object-oriented design	55%
Built with CASE tools provided with package	46%

1 = low acceptability, 5 = high acceptability

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Exhibit 4

LANGUAGE IMPORTANCE FOR MODIFICATION PURPOSES

Language	Percent of Companies
C++	30%
Cobol	19%
RPG	6%
Smalltalk	3%
C	2%
4GLs	4%
Other	4%

Exhibit A-1

COMPANIES WITH HIGH PROBABILITY OF REPLACING APPLICATIONS IN THE NEXT FIVE YEARS

	Percent of Companies at		
	50-90% Probability Level	95-100% Probability Level	Total 50-100% Probability Level
Financials	33%	28%	61%
Warehouse Mgt	28%	22%	50%
Factory Mgt	28%	20%	48%
Human Resources	24%	22%	46%
Order Processing	20%	22%	42%
MRP	17%	23%	40%
Engineering	18%	22%	40%
Procurement	19%	20%	39%

APPLICATIONS DEVELOPMENT IN THE MANUFACTURING SECTOR

I am calling from INPUT, a research and consulting firm in Teaneck, New Jersey. We are conducting a study on applications development in manufacturing. The information that you provide will be confidential and neither your name nor your company's name will be connected with any of the information in this study. In return for your assistance, we will provide you with a summary of the study's findings at no charge.

1a. Which of the following applications may be replaced in your firm in the next five years? What is the approximate probability of this occurring (for each application)? [Use table below.]

1b. What events could increase or decrease these probabilities? [For applications that may be replaced, use table below.]

1c. Is your firm considering the use of software packages or consulting services for applications that may be replaced? [Use table below.]

IF PACKAGES OR SERVICES ARE BEING CONSIDERED, GO TO 2.

Application	% Prob	Rationale for Increase/Decrease	Pkg/Svc (Y/N)
MRP	_____	_____	_____
Order Processing	_____	_____	_____
Warehouse Mgt	_____	_____	_____
Factory Mgt	_____	_____	_____
Procurement	_____	_____	_____
Engineering	_____	_____	_____
Financials	_____	_____	_____
Human Resources	_____	_____	_____

2a. What is driving the replacement?

_____

_____

_____

2b. In evaluating software packages for the applications above, please rate the importance of the following selection criteria below, using a scale of 1 to 5, with 5 being highest importance. Please comment on your rating; for example, if the criteria apply to one application more than another.

Criteria	Rating	Comments
Extensive Built-in Features	_____	_____
Full Installation Support	_____	_____
Vendor-provided Product Modifications	_____	_____
Software Modifiable by Customer	_____	_____
Client/Server Technology	_____	_____
Easy to integrate	_____	_____
Hardware independent	_____	_____
Conforms to standards	_____	_____
Vendor reputation	_____	_____
Other		
_____	_____	_____
_____	_____	_____

3. In performing modifications, there are six elements involved:

	Rank
• Access to source code	_____
• The programming language used	_____
• Structure and quality of code	_____
• Adherence to standards	_____
• The documentation available	_____
• Access to knowledgeable technical staff	_____

Please rank the importance of these elements (from one to six, with one being the most important) and explain your reasoning. In the case of languages, which language (or languages) is preferred?

Explanation

_____

_____

_____

4. I would like to look at the issues involved with software modification in more depth. For your company, by 1995 how acceptable is each of the following enabling technologies, assuming that it was built into an application (1= low acceptability, 5= high acceptability)? Please give the reason for your rating.

Technology	Rating	Reasons
Object-oriented design	_____	_____
Object-Oriented database	_____	_____
Built with CASE tools provided with package	_____	_____
Distributed data base technology	_____	_____
Relational DBMS	_____	_____
Written in C+ +	_____	_____
Written in Smalltalk	_____	_____
Written in another language (_____)	_____	_____
Other (_____)	_____	_____

5. If the designers of a packaged software application asked your advice on the critical issues involving the next generation of software, what advice would you give?

_____

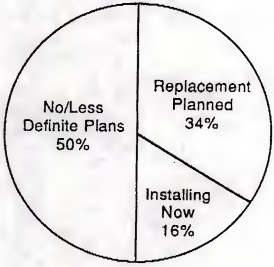
_____

_____

THANK YOU FOR YOUR PARTICIPATION.

YNSW2 Exhibit 13

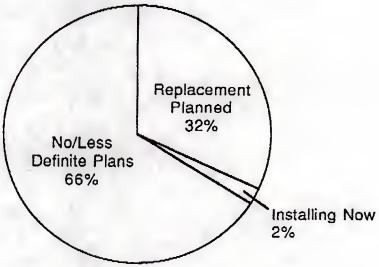
Replacement Status for Priority Applications
Medium-Sized Drug and Chemical Companies
(Targeted Manufacturing Applications)



N = 68

YNSW2 Exhibit 14

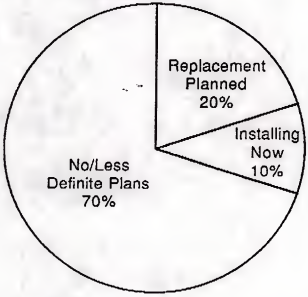
Replacement Status for Priority Applications
Large Drug and Chemical Companies
(Targeted Manufacturing Applications)



N = 56

YNSW2 Exhibit 18

Replacement Status for Priority Applications Resource Planning

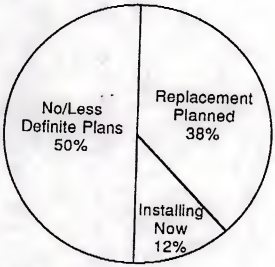


N = 10

Note: Small sample

YNSW2 Exhibit 16

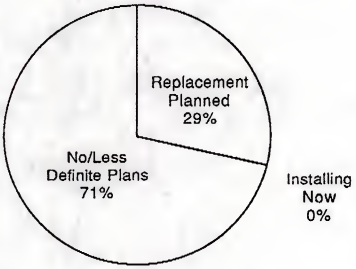
Replacement Status for Priority Applications Environmental



N = 16

YNSW2 Exhibit 17

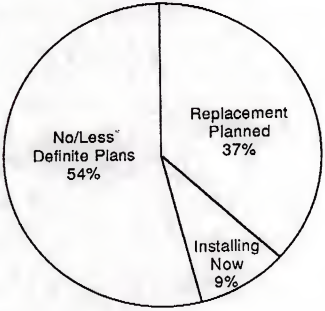
Replacement Status for Priority Applications
Product Management



N = 17

YNSW2 Exhibit 21

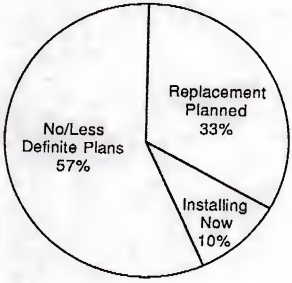
Replacement Status for Priority Applications
All Applications



N = 191

YNSW2 Exhibit 20

Replacement Status for Priority Applications
Targeted Manufacturing Applications

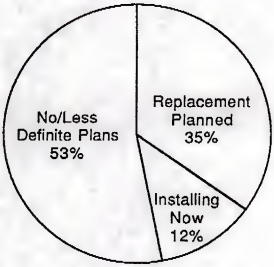


N = 124

Note: Omits financial and "other" applications

YNSW2 Exhibit 15

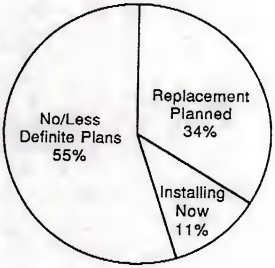
Replacement Status for Priority Applications
Plant Operations



N = 43

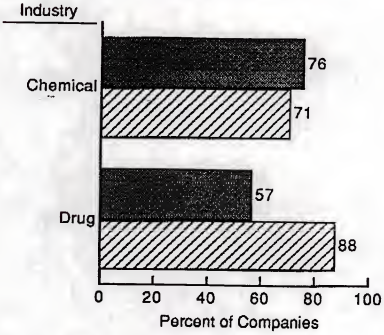
YNSW2 Exhibit 19

Replacement Status for Priority Applications
Customer Service



N = 38

Percent of Companies with Increased Rate of Application Change/Replacement in Last Five Years



Size: $100 Million - $1 Billion

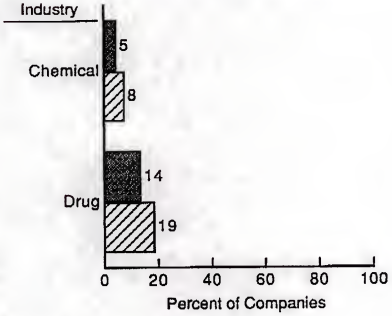
Over $1 Billion

Unweighted average: 73%

Source: Surveys of 83 chemical and drug companies/divisions

YNSW2 Exhibit 3

Percent of Companies Citing Distribution as a Priority Application



Size: ■ $100 Million - $1 Billion

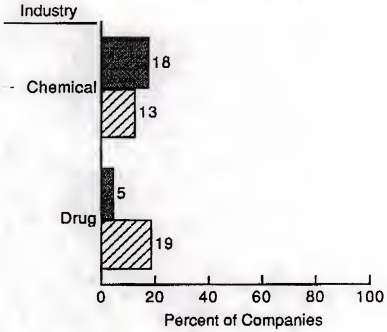
▨ Over $1 Billion

Unweighted average: 12%

Source: Surveys of 83 chemical and drug companies/divisions

YNSW2 Exhibit 5

Percent of Companies Citing Order Entry as a Priority Application



Size: ■ $100 Million - $1 Billion

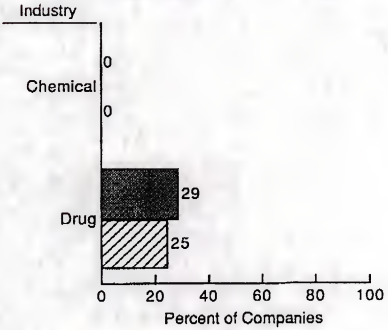
▨ Over $1 Billion

Unweighted average: 14%

Source: Surveys of 83 chemical and drug companies/divisions

YNSW2 Exhibit 4

Percent of Companies Citing Sales and Marketing as a Priority Application



Size: $100 Million - $1 Billion

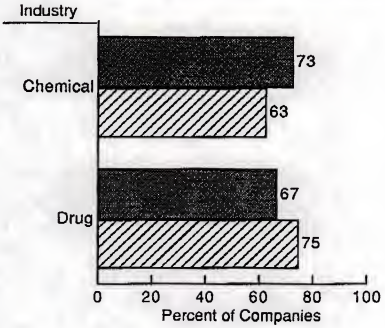
Over $1 Billion

Unweighted average: 14%

Source: Surveys of 83 chemical and drug companies/divisions

YNSW2 Exhibit 1

Percent of Companies Citing Plant Operations as a Priority Application



Size: $100 Million - $1 Billion

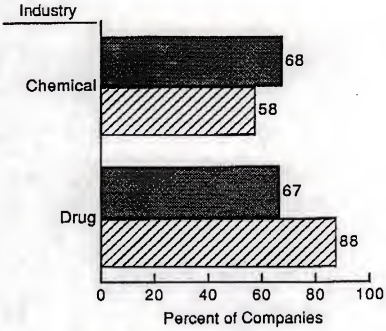
Over $1 Billion

Unweighted average: 70%

Source: Surveys of 83 chemical and drug companies/divisions

YNSW2 Exhibit 9

Percent of Companies Citing Customer Service as a Priority Application



Size: $100 Million - $1 Billion

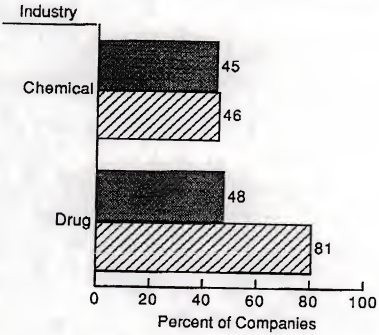
Over $1 Billion

Unweighted average: 70%

Source: Surveys of 83 chemical and drug companies/divisions

YNSW2 Exhibit 7

Percent of Companies Citing Product Management as a Priority Application



Size: $100 Million - $1 Billion

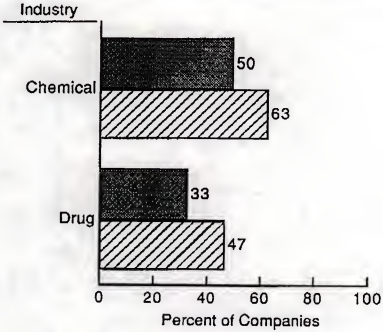
Over $1 Billion

Unweighted average: 55%

Source: Surveys of 83 chemical and drug companies/divisions

YNSW2 Exhibit 10

Percent of Companies Citing Environmental, Health, Safety, and Training as a Priority Application



Size: $100 Million - $1 Billion

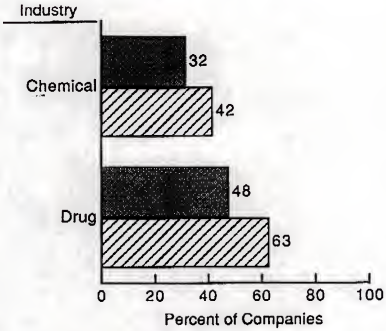
Over $1 Billion

Unweighted average: 48%

Source: Surveys of 83 chemical and drug companies/divisions

YNSW2 Exhibit 8

Percent of Companies Citing Resource Planning as a Priority Application



Size: $100 Million - $1 Billion

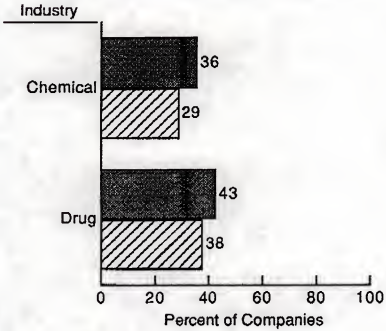
Over $1 Billion

Unweighted average: 46%

Source: Surveys of 83 chemical and drug companies/divisions

YNSW2 Exhibit 6

Percent of Companies Citing Financial Systems as a Priority Application



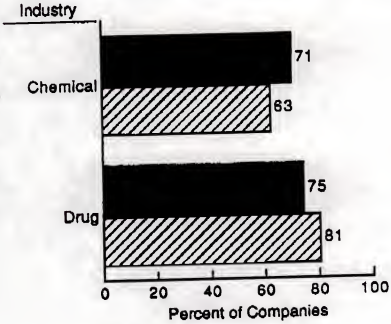
Size: $100 Million - $1 Billion

Over $1 Billion

Unweighted average: 37%

Source: Surveys of 83 chemical and drug companies/divisions

Percent of Companies Where End Users Have Primary Decision-Making Authority for Replacing/Changing Application Software



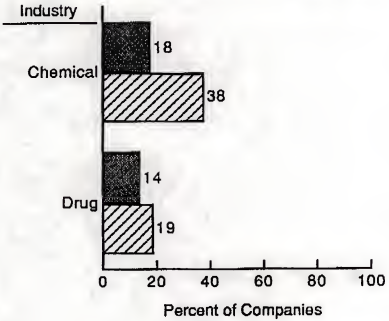
Size: ■ $100 Million - $1 Billion

▨ Over $1 Billion

Source: Surveys of 83 chemical and drug companies/divisions.
"Primary" = 50% or more.

YNSW2 Exhibit 2

Percent of Companies Citing Other Systems as a Priority Application



Size: $100 Million - $1 Billion

Over $1 Billion

Unweighted average: 22%

Source: Surveys of 83 chemical and drug companies/divisions

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- **Client/Server Software**
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Databases

- **Software and Services Market Forecasts**
- **Software and Services Vendors**
- **U.S. Federal Government**
  - Procurement Plans (PAR)
  - Forecasts
  - Awards (FAIT)
- **Commercial Application (LEADS)**

Custom Projects

For Vendors—analyze:

- **Market strategies and tactics**
- **Product/service opportunities**
- **Customer satisfaction levels**
- **Competitive positioning**
- **Acquisition targets**

For Buyers—evaluate:

- **Specific vendor capabilities**
- **Outsourcing options**
- **Systems plans**
- **Peer position**

Other Services

Acquisition/partnership searches

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